

Motivation:

Since 1978, there have only been 8 childhood cancer therapies approved by the FDA. Improvements of tools used for drug evaluation that are: reliable, cost-effective, and repeatable are critical for developing new therapies.

Background:

Preclinical therapies are tested in-vitro (isolated tissues, organs, or cells) and then in-vivo (animal models). In-vivo testing provides more compressive results but is prohibitively expensive.

The Chorioallantoic membrane (CAM) of a quail embryo can be used to reduce costs by providing an intermediate step between in-vitro and animal models. Our goal is to improve the tools used for the evaluation of CAM assays to increase reliability.

Value Proposition:

Currently, there is no system for an automated and continuous monitoring of Chorioallantoic membrane (CAM) embryos during testing.

Completion of our project will result in:

- Increased reliability and repeatability of quail embryo experiments by allowing researchers to continuously monitor development and vitals
- Increased ability to quantify the impact of therapies on quail embryos

Key Requirements:

Sensor Requirements:

- Heart rate - Acoustocardiography, Ballistocardiograph
- Oxygen saturation - Photoplethysmography
- pH - pH Dye and MATLAB color analysis
- CAM blood vessel branch counting – VESGEN

Other Considerations:

- Minimal to non-invasive sensor placement
- Aseptic
- User friendly

Acknowledgements:

- We would like to thank our external sponsors Dr. Keller, and The Children's Cancer Therapy Development Institute.
- In addition, we would like to thank: The University of Idaho College of Engineering, our mentor Jack and lead instructor Dev Shrestha.
- Thank you!

IACUC Approval:

Institutional Animal Care and Use Committee

- CITI Training
- AWMSP Consent Forms
- AWMSP Medical History Forms
- Detailed protocol

Incubation and Sensor Validation

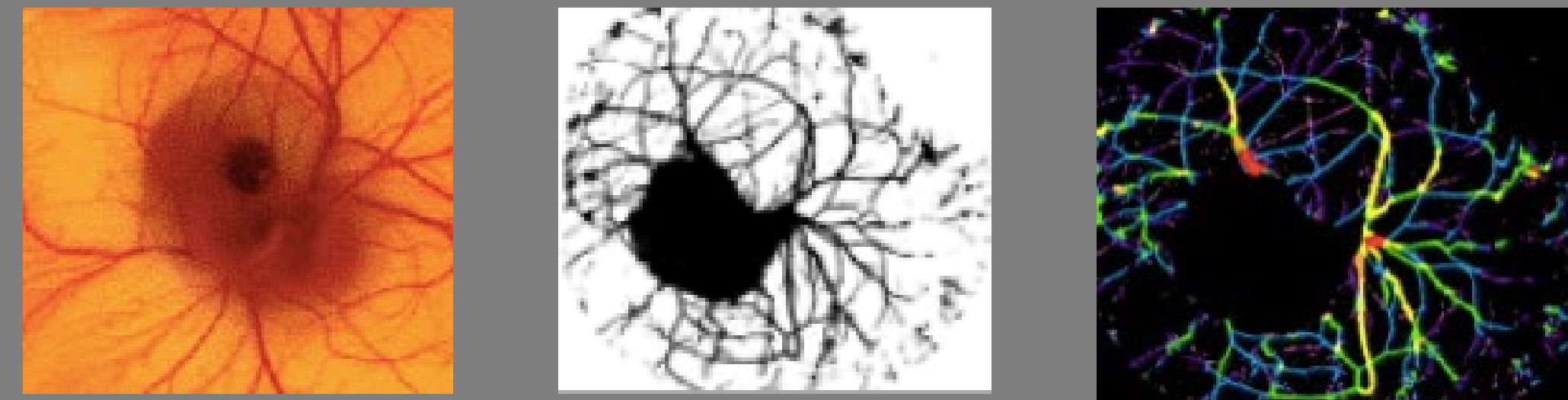


Figure 1: VESGEN software vessel branch counting and analysis

Incubation:

- Eggs were incubated in JML up to 18 days
- Heart rate and sensor validation was completed day 5-18



Figure 2: Incubated embryo for sensor validation



Figure 3: pH dye used in combination with MATLAB to determine pH value.

Validation:

- Sensors were validated using Japanese quail (*Coturnix Japonica*) incubated in JML
- Each sensor required unique development and design requirements

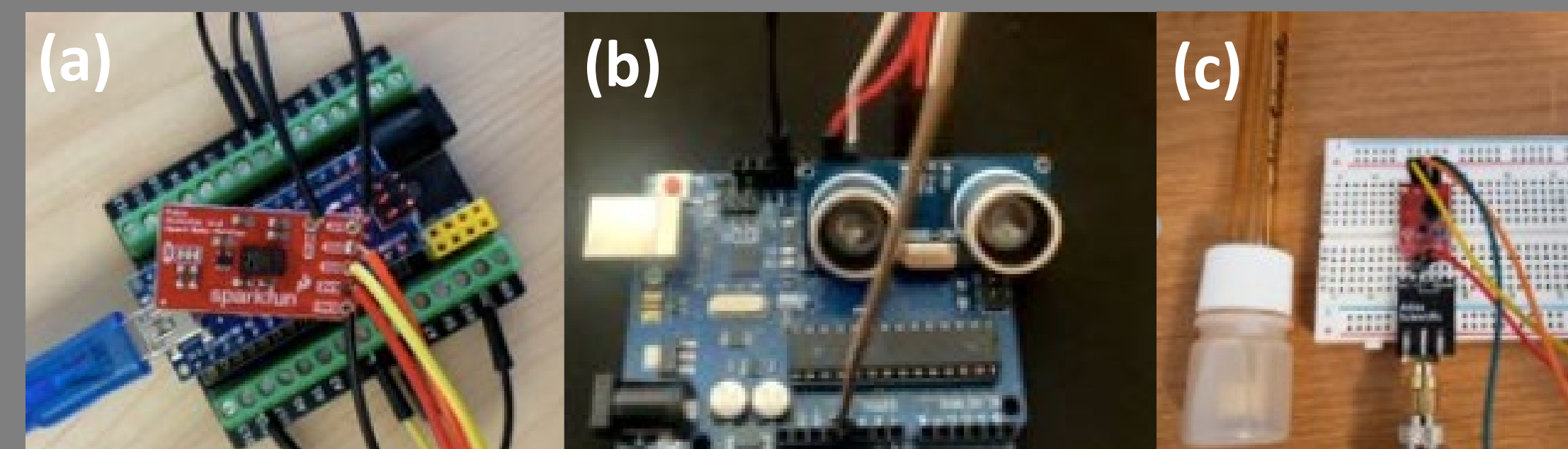


Figure 4: Instrumentation for (a) Photoplethysmography, (b) Acoustocardiograph, and (c) pH testing. Each sensor provided unique design considerations, such as lighting, background noise, and space.

Challenges:

- IACUC approval
- Sterility of incubation environment
- Embryo death
- Unique design considerations for sensors
- Sensor integration into 3D design

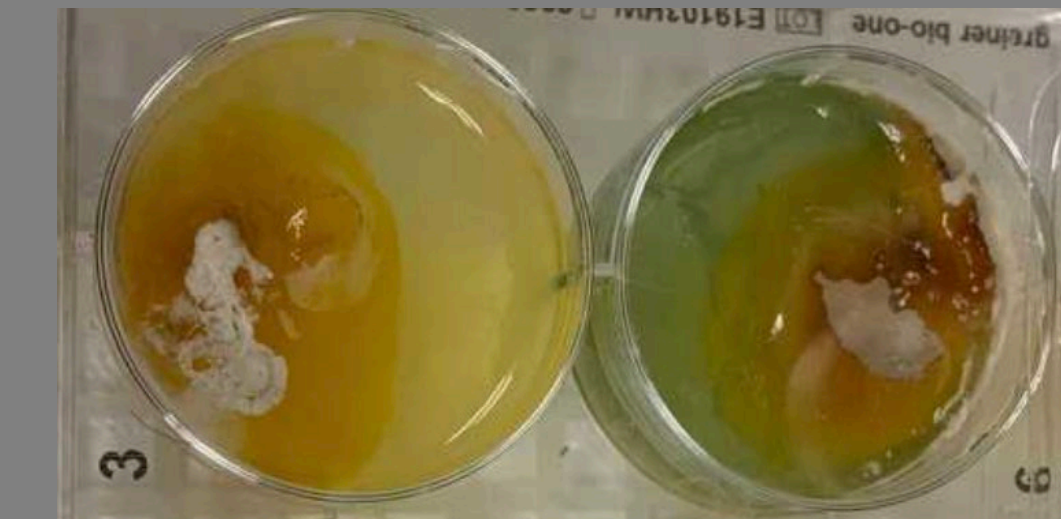


Figure 5: Mold in the incubator and infection spread between eggs proved a challenge for incubation and sensor validation. Different containers were used for incubation throughout the project including Eppendorf tubes, six-well plates, and Petri dishes.

Final Design:

Our final design utilized a mounted camera and foam sensor platform.

Foam sensor platform

- Uniform contact with the embryo
- Interchangeability and adjustability of sensors.

Screw on cup

- Easy access to sensor bed
- Easy to clean

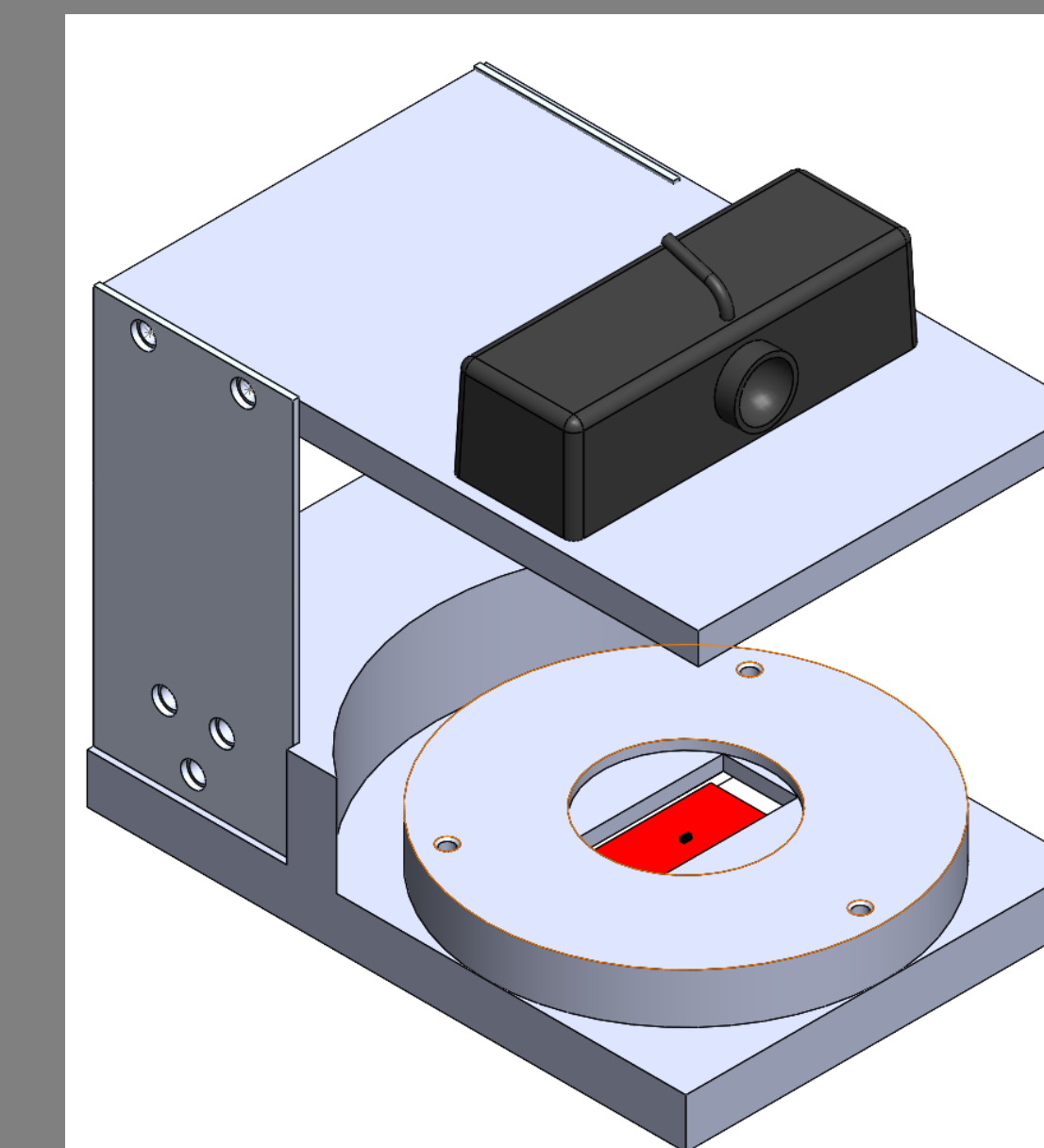
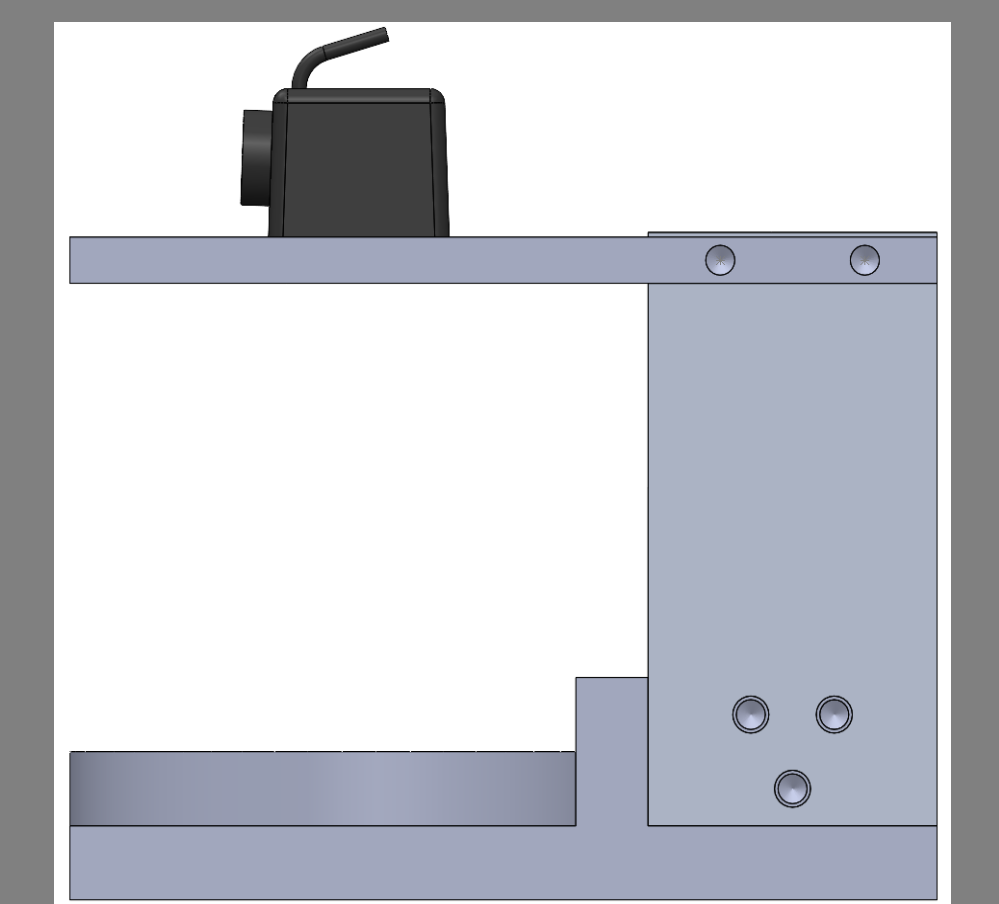


Figure 6: To the right shows our final 3D design using a mounted camera, cup, and embedded sensor platform.



Future Work:

- Further sensor validation and development
- Increased emphasis on material selection in 3D design
- Further validation and modification of combined prototype
- Increased emphasis on user interface